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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/647,433	08/26/2003	Takanori Mimura	033082 M 172	1732

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EXAMINER

TRAN, BINH X

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 10/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/647,433

Applicant(s)

MIMURA ET AL.

Examiner

Binh X. Tran

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 September 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) 16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7,9,10,14,15 and 17-19 is/are rejected.
- 7) ☒ Claim(s) 8 and 11-13 is/are objected to.
- 8) ☒ Claim(s) 1-19 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 9/26/05.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Species A (claims 1-15, 17-19) in the reply filed on 9-26-2005 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).
2. Claim 16 is withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 9-26-2005.

Specification

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

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the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-7, 9, 14, 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Komura et al. (US 5,423,941) in view of Grimbergen et al. (US 6,712,927).

Respect to claim 1, Komura disclose a method of etching a Si target object, which is a silicon substrate (201) or a silicon layer (1703) formed a substrate, by using a plasma comprising the steps of:

placing the Si target object, coated with a mask (202 or 1704), in a processing vessel (See Fig 2B, Fig 3, Fig 11B);

supplying a mixed etching into the processing vessel, the etching gas containing fluorosulfur (SF_6), O_2 gas and fluorosilicon (SiF_4) (Table 1, col. 4);

applying the first RF voltage (306) having first frequency to a first electrode (305) to couple RF power from the first electrode (305) to a second electrode (304) in the processing vessel, thereby generating a plasma from the etching gases (col. 4).

Komura fails to disclose the first frequency is 40 MHz or above. Grimbergen discloses the RF frequency of the electrode is a result effective variables ranges from 350 KHz to 60 MHz (col. 6 lines 42-43, within applicant's range). The result effective

variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Komura in view of Grimbergen by perform routine to obtain optimal frequency as an expected result.

Respect to claim 2, Komura discloses the flow rate of fluorosilicon in the range of 0-20 sccm as well as other etchant gas flow rate (Table 6). Any person having ordinary skill in the art would be able to convert individual flow rate value to percentage value if the total flow is known.

Respect to claim 3, Komura discloses the flow rate of He and O₂ is 8 sccm, and the flow rate of fluorosulfur (i.e. SF₆) equals to 3 sccm (Table 1, example 1). Komura further discloses the He:O₂ ratio is 7:3.

Base on this data, the flow rate of oxygen equals to $8 * (3 / (7+3)) = 2.4$ sccm. Therefore the ratio of O₂ gas concentration to a fluorosulfur is $2.4 / 3 = 0.8$ (read on applicant's range).

Respect to claim 4, Komura disclose a magnetic field (by using magnetic coil 307) is created between the electrodes (304 and 305) at least when applying the first RF voltage, wherein a direction of the magnetic field is perpendicular to a direction of an electric field created between the electrodes (304 and 305) by applying the first RF voltage (Fig 3).

Respect to claim 5, Komura fails to disclose the magnetic field has a magnetic flux density of 170 G or above. Grimbergen discloses the magnetic flux density is a

result effective variable ranging from 50 G to 2000 G in order to confine charged particles (col. 17 lines 58-67, col. 8 lines 1-10). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment in order to obtain optimal magnetic flux density.

Respect to claim 6, Komura disclose the processing vessel is provided with a susceptor adapted to support the object thereon, and the first RF power source (306) is electrically connected to the susceptor to apply the first RF voltage the susceptor serving as the first electrode (305) (See Fig 3A).

Respect to claim 7, Grimbergen discloses the second RF power source is electrically connected to the susceptor, the second RF power source (104) having the second frequency. Since Grimbergen discloses the frequency for first and second power source is a result effective variable ranging from 50 KHz to 60 MHz. It is possible to have the second power frequency lower than the first power source (60 MHz).

Respect to claim 9, Komura discloses the pressure is in the range of 50-150 mTorr (See Table 6, within applicant's range).

Respect to claim 14, Komura discloses the etching process form trenches having a depth of about 20 μm and a width of about 1-120 μm (col. 7 lines 15-24). Komura further discloses the flow rate of: SF_6 equals 3 sccm (Table 1), O_2 equals 2.4 sccm (See previous calculation) and SiF_4 equals 4 sccm (Table 1). Therefore the flow rate ratio

between fluorosulfur, O₂ gas and fluorosilicon is 3/2.4/4, which equals to 0.8/0.6/1 (within applicant's range).

Respect to claim 17, Komura discloses the pressure is in the range of 50-150 mTorr (See Table 6, within applicant's range). Respect to claims 18-19, Komura discloses the fluorosulfur gas is SF₆ and fluorosilicon gas is SiF₄ (Table 6).

7. Claim 10 rejected under 35 U.S.C. 103(a) as being unpatentable over Komura and Grimbergen as applied to claim 1 above, and further in view of Leung et al. (US 2003/0235993).

Respect to claim 10, Komura and Grimbergen fails to disclose the temperature of the object supporting surface. Leung discloses to control the backside of the substrate on the substrate support at a temperature of about 15 °C in order to volatilize most of the etch product (paragraph 0035, read on applicant's temperature range). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Komura and Grimbergen in view of Leung by control the temperature because it will help to volatilize most of the etch product.

8. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Komura and Grimbergen as applied to claim 14 above, and further in view of Collins et al. (US 5,00,460).

Respect to claim 15, Komura discloses the mask comprises SiO₂ (col. 3 lines 29-30). Claim 15 differs from Komura and Grimbergen by the specific RF power flux density value. In an etching process for silicon, Collins teaches power flux density is a result effective variable range from 30 watts/inch² to 50 watt/inch² (equals to 4.65

watt/cm² to 7.75 Watts/cm²; See col. 4 lines 30-35, within applicant's range). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Komura and Grimbergen in view of Collins by performing routine experiments to obtain optimal power flux density as an expected result.

Allowable Subject Matter

9. Claims 8, 11-13 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. The following is a statement of reasons for the indication of allowable subject matter: The cited prior arts fail to disclose or suggest either one of the following in conjunction with all other limitation in the claims: the second frequency is 3.2 MHz; or the etching create a holes or trench with the depth of about 15 μm or below and the width of about 3 μm or below using the mixed gas with flow rate ratios between those of fluorosulfur or fluorocarbon gas, O₂ gas and fluorosilicon gas being in the range of 1/(0.6 to 0.67)/(0.33 to 2.33).

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-

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1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh Tran

Binh X. Tran